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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/575,120	04/07/2006	Ryoji Nomura	0553-0492	9220

24628 7590 09/21/2010

Husch Blackwell Sanders, LLP
Husch Blackwell Sanders LLP Welsh & Katz
120 S RIVERSIDE PLAZA
22ND FLOOR
CHICAGO, IL 60606

EXAMINER	
CROUSE, BRETT ALAN	

ART UNIT	PAPER NUMBER
1786	

MAIL DATE	DELIVERY MODE
09/21/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	**Application No.** 10/575,120	**Applicant(s)** NOMURA ET AL.	
	Examiner Brett A. Crouse	**Art Unit** 1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _10 August 2010_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-6 and 9-15_ is/are pending in the application.

4a) Of the above claim(s) _3-5_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1,2,6 and 9-15_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _20100810_.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10 August 2010 has been entered.

Status of Claims

2. The amendment, filed 10 August 2010, cancels claims 7 and 8, amends claims 1-5 and adds new claim 15.

3. Claims 1, 2, 6 and 9-15 are under consideration.

Response to Amendment

4. The rejections of record are overcome by the amendment, filed 10 August 2010.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

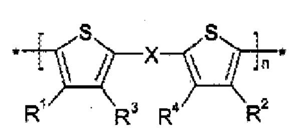
> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2, 6, 7, 8, 9, 10, 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heeney et al., EP 1,439,590 in view of Tokito et al., Journal of Physics: Applied Physics, (1996), Volume 29, Pages 2750-2753 and Kido et al., US 2003/0189401 with further evidence provided by Liu et al., Applied Physics Letters, (2007), Volume 91, 142106.

Heeney teaches:

Paragraph [0102], teaches an electroluminescent device comprising mono-, oligo- or poly-mers of formula (I). The passage additionally teaches multilayer electroluminescent device structures comprising hole transport layer(s), electron transport layer(s) and emission layer(s) and applying a voltage across such a structure.

Paragraphs [0026]-[0029], claim 1, formula (I), teach mono-, oligo- or poly-mers of formula (I), shown below, in the charge transport or electroluminescent layers of an organic light emitting diode. The mers of formula (I) can be used alone or in combination. X of formula (I) can be a substituted or unsubstituted arylene or heteroarylene group.



Paragraph [0079], teaches the compositions comprising mers of formula (I) can further comprise additional materials including transition metal compounds.

Paragraphs [0028] [0030]-[0033], [0080], teach the use of the materials of formula (I) in displays and backlights.

Heeney does not teach:

Heeney does not teach transition metal oxides.

Tokito teaches:

Page 2750, teaches the use of various transition metal oxides to reduce the energy barrier and improve hole injection from an ITO or AZO anode into an electroluminescent device. Vanadium oxide, molybdenum oxide and ruthenium oxide are taught as exemplified materials.

Page 2752, figure 4, teaches the effect on the operating voltage versus the work function of the metal oxide selected.

It would have been obvious to one of ordinary skill in the art to use the transition metal oxides of Tokito as the transition metal compounds suggested by Heeney to obtain the improved charge injection from the ITO electrode of Heeney as observed by Tokito.

Heeney/Tokito does not teach:

Heeney/Tokito does not teach a device structure comprising the mers of Heeney in a first and second layer with a light emitting layer therebetween.

Kido teaches:

Paragraph [0025], teaches the invention of Kido is directed to organic electroluminescent devices having at least one charge generating layer and at least two light emissive units

which provide higher luminance than electroluminescent devices having only a single light emissive unit.

Paragraph [0027], teaches the charge generating layer(s) include laminated and/or mixed layers. A charge transfer complex having a radical cation and radical anion is formed.

Paragraph [0028], teaches it is desirable for the charge generation layer to include an organic compound having an ionization potential of less than 5.7 eV and a second inorganic or organic compound capable of forming a charge transfer complex therewith.

Paragraphs [0029]-[0032] and [0119]-[0134], formula (I), teach an organic compound preferably having a glass transition temperature of not lower than 90 degrees Celsius. Suitable arylamine example compounds are presented including alpha-NPD.

Paragraphs [0038]-[0040], [0255], teach the organic material can include fluoro groups, cyano groups, and both fluoro and cyano groups. (4F-TCNQ) tetrafluoro-tetracyano-quinodimethane is presented as an example of a suitable compound. The structure of (4F-TCNQ) is presented in paragraph [0255].

Paragraphs [0041]-[0049], teach an electron injection layer on the anode side of the charge generation layer. The electron injection layer can comprise an organic metal complex or inorganic compound and a reaction generating layer formed by in-situ reduction with a thermally reducible metal. Aluminum, zirconium, silicon, titanium, and tungsten are taught as thermally reducible metals. The passage additionally teaches the layer can be a mixed layer.

Paragraphs [0050]-[0052], teach a hole injection layer comprising an organic compound and electron accepting compound. The electron accepting compound can oxidize the organic compound.

Paragraph [0135], [0141] and [0142], teach the charge generating layer can also function as the hole transporting layer. The passage also teaches the charge generation layer can be a mixed layer further comprising a substance capable of forming a charge-transfer complex with the arylamine component.

Paragraph [0155], teaches an organic layer adjacent to the cathode can comprise an organic metal complex having as the metal of the complex an alkaline or alkaline earth metal and a thermally reducible metal such as Al.

Paragraphs [0293]-[0305], example 6, figure 41, teaches a reaction generating layer of Liq and Al adjacent to the charge generation layer. The charge generation layer comprises vanadium pentaoxide and alpha-NPD.

Liu as further evidence:

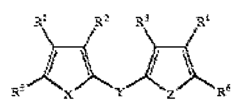
Liu is added to provide the charge mobility of holes and electron in alpha-NPD (NPB). Figure 1 of Liu, 142106-2, teaches the charge mobility of holes and electrons in NPB at various electric field strengths.

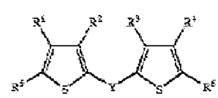
It would have been obvious to one of ordinary skill in the art to provide a plurality of light emissive units of Heeney/Tokito with the charge generation units of Kido therebetween to obtain increased luminance in the resulting device as observed by Kido.

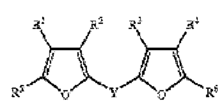
7. Claims 1-6, 9-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takasu et al., US 2004/0258954 in view of Heeney et al., EP 1,439,590 and Tokito et al., Journal of Physics: Applied Physics, (1996), Volume 29, Pages 2750-2753, and Hosokawa, US 2002/0045061 and Kido et al., US 2003/0189401 with further evidence provided by Liu et al., Applied Physics Letters, (2007), Volume 91, 142106, and Angelopoulos et al., US 5,198,153.

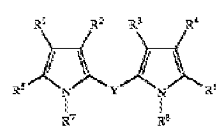
Takasu teaches:

Paragraphs [0025]-[0031], formulae 5,6,7,8, teach an electroluminescent device comprising a molecule represented by the formulae, shown below.









Paragraph [0032], teaches Y of the formulae represents an arylene group.

Paragraphs [0098], [0104], [0112], [0121], [0125], [0128], provide exemplified compounds in which further fused rings are formed from R^1, R^2 and R^3, R^4.

Paragraph [0059], teaches various electroluminescent device structures. The passage additionally teaches the materials of the formulae can be used in the hole injection, hole transport, and luminescent layers of the device.

Paragraph [0061], teaches various materials suitable for use in the layers of the electroluminescent device.

Paragraphs [0067]-[0068], figures 2A, 2B, teach the use of the electroluminescent device as a pixel

Paragraphs [0086]-[0089], teach the use of the electroluminescent device in various display applications including televisions, personal computers, and telephones.

Takasu does not teach:

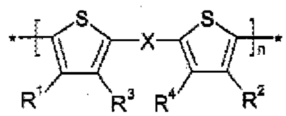
Takasu does not teach an electron acceptor as a dopant to the layer comprising the material of the formulae.

Takasu does not teach the use of the materials of the formulae in the electron transport/injection layers of an electroluminescent device.

Heeney teaches:

Paragraph [0102], teaches an electroluminescent device comprising mono-, oligo- or poly-mers of formula (I). The passage additionally teaches multilayer electroluminescent device structures comprising hole transport layer(s), electron transport layer(s) and emission layer(s) and applying a voltage across such a structure.

Paragraphs [0026]-[0029], [0080], claim 1, formula (I), teach mono-, oligo- or poly-mers of formula (I), shown below, in the charge transport, charge injection, or electroluminescent layers of an organic light emitting diode. The mers of formula (I) can be used alone or in combination. X of formula (I) can be a substituted or unsubstituted arylene or heteroarylene group.



Paragraphs [0077]-[0079], teaches the compositions comprising mers of formula (I) can further comprise additional materials including transition metal compounds. The passage also incorporates by reference, Angelopoulos et al., US 5,198,153 in paragraph [0077].

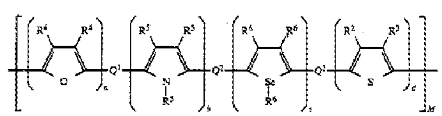
Paragraphs [0028] [0030]-[0033], [0080], teach the use of the materials of formula (I) in displays and backlights.

Angelopoulos as further evidence:

Angelopoulos is incorporated by reference into Heeney in paragraph [0077].

Column 17, lines 52-57, teach doped polymers can provide conductivity on the order of 10 ohm^{-1} cm^{-1}.

Column 16, lines 8-24, formula, teach suitable (co)polymers include thiophenes, furans, pyrroles and combinations thereof. The formula is reproduced below.



It would have been obvious to one of ordinary skill in the art to use the doped thiophene, furan, and pyrrole (co)polymers as taught by Heeney in device of Takasu as charge transporting materials in the light emitting, hole injection/transport and electron injection/transport layers to provide high conductivity to the layer(s) of the device to improve device efficiency.

Takasu / Heeney does not teach:

Takasu / Heeney does not teach transition metal oxides.

Tokito teaches:

Page 2750, teaches the use of various transition metal oxides to reduce the energy barrier and improve hole injection from an ITO or AZO anode into an electroluminescent device. Vanadium oxide, molybdenum oxide and ruthenium oxide are taught as exemplified materials.

Page 2752, figure 4, teaches the effect on the operating voltage versus the work function of the metal oxide selected.

It would have been obvious to one of ordinary skill in the art to use the transition metal oxides of Tokito as the transition metal compounds suggested by Heeney to obtain the improved charge injection from the ITO electrode of Takasu / Heeney as observed by Tokito.

Takasu / Heeney / Tokito does not teach:

Takasu does not teach an electron generation layer.

Hosokawa teaches:

Paragraphs [0109]-[0115], teach a hole barrier layer improves device performance by confining holes in the luminescence layer. The passage additionally provides a preferred composition of the hole barrier layer comprising BPhen or BCP in combination with Li or Cs.

Paragraph [0160], example 3, teaches 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (Bathocuproine)(BCP) co-deposited with cesium in a hole barrier layer deposited upon the luminescent layer.

Paragraph [0103], teaches it is preferred to include a semiconductor layer having an electrical conductivity of at least 10^{-10} S/cm between the anode and light emitting layer.

It would have been obvious to one of ordinary skill in the art to use the hole barrier layer of Hosokawa in the device of Takasu to improve the hole confinement in the light emitting layer and improve device performance as suggested by Hosokawa.

It would have been obvious to one of ordinary skill in the art to include a layer of the doped material of Takasu/Heeney in the device of Takasu/Heeney between the anode and light emitting layer to provide a high conductivity layer to improve hole injection into the light emitting layer. Such a layer would be expected to meet the limitations of a electron generation layer as indicated on page 18 of the instant specification.

Takasu / Heeney / Tokito / Hosakawa does not teach:

Takasu does not teach a device structure comprising a plurality of light emitting units.

Kido teaches:

Paragraph [0025], teaches the invention of Kido is directed to organic electroluminescent devices having at least one charge generating layer and at least two light emissive units which provide higher luminance than electroluminescent devices having only a single light emissive unit.

Paragraph [0027], teaches the charge generating layer(s) include laminated and/or mixed layers. A charge transfer complex having a radical cation and radical anion is formed.

Paragraph [0028], teaches it is desirable for the charge generation layer to include an organic compound having an ionization potential of less than 5.7 eV and a second inorganic or organic compound capable of forming a charge transfer complex therewith.

Paragraphs [0029]-[0032] and [0119]-[0134], formula (I), teach an organic compound preferably having a glass transition temperature of not lower than 90 degrees Celsius. Suitable arylamine example compounds are presented including alpha-NPD.

Paragraphs [0038]-[0040], [0255], teach the organic material can include fluoro groups, cyano groups, and both fluoro and cyano groups. (4F-TCNQ) tetrafluoro-tetracyano-quinodimethane is presented as an example of a suitable compound. The structure of (4F-TCNQ) is presented in paragraph [0255].

Paragraphs [0041]-[0049], teach an electron injection layer on the anode side of the charge generation layer. The electron injection layer can comprise an organic metal complex or inorganic compound and a reaction generating layer formed by in-situ reduction with a thermally reducible metal. Aluminum, zirconium, silicon, titanium, and tungsten are taught as thermally reducible metals. The passage additionally teaches the layer can be a mixed layer.

Paragraphs [0050]-[0052], teach a hole injection layer comprising an organic compound and electron accepting compound. The electron accepting compound can oxidize the organic compound.

Paragraph [0135], [0141] and [0142], teach the charge generating layer can also function as the hole transporting layer. The passage also teaches the charge generation layer can be a mixed layer further comprising a substance capable of forming a charge-transfer complex with the arylamine component.

Paragraph [0155], teaches an organic layer adjacent to the cathode can comprise an organic metal complex having as the metal of the complex an alkaline or alkaline earth metal and a thermally reducible metal such as Al.

Paragraphs [0293]-[0305], example 6, figure 41, teaches a reaction generating layer of Liq and Al adjacent to the charge generation layer. The charge generation layer comprises vanadium pentaoxide and alpha-NPD.

Liu as further evidence:

Liu is added to provide the charge mobility of holes and electron in alpha-NPD (NPB). Figure 1 of Liu, 142106-2, teaches the charge mobility of holes and electrons in NPB at various electric field strengths.

It would have been obvious to one of ordinary skill in the art to provide a plurality of light emissive units of Takasu with the charge generation units of Kido therebetween to obtain increased luminance in the resulting device as observed by Kido.

8. Claims 1, 2, 6, 7, 8, 9, 10, 14, 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heeney et al., EP 1,439,590 in view of Ikeda et al., WO 2005/031798 and Kido et al., US 2003/0189401 with further evidence provided by Liu et al., Applied Physics Letters, (2007), Volume 91, 142106.

Heeney teaches:

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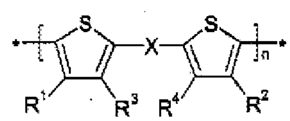
device structures comprising hole transport layer(s), electron transport layer(s) and emission layer(s) and applying a voltage across such a structure.

Paragraphs [0026]-[0029], claim 1, formula (I), teach mono-, oligo- or poly-mers of formula (I), shown below, in the charge transport or electroluminescent layers of an organic light emitting diode. The mers of formula (I) can be used alone or in combination. X of formula (I) can be a substituted or unsubstituted arylene or heteroarylene group.



Paragraph [0079], teaches the compositions comprising mers of formula (I) can further comprise additional materials including transition metal compounds.

Paragraphs [0028] [0030]-[0033], [0080], teach the use of the materials of formula (I) in displays and backlights.

Heeney does not teach:

Heeney does not teach transition metal oxides.

Ikeda teaches:

Abstract, teaches a light emitting device comprising a layer which further comprises a hole transporting compound and a oxide semiconductor or metal oxide.

Page 3, teaches exemplified examples of the oxide semiconductor or metal oxide. The examples include vanadium oxide, molybdenum oxide, tungsten oxide and ruthenium oxide.

It would have been obvious to one of ordinary skill in the art to use the transition metal oxides of Ikeda as the transition metal compounds suggested by Heeney to obtain the improved charge transportation and improved device life as observed by Ikeda.

Heeney / Ikeda does not teach:

Heeney does not teach a device structure comprising a plurality of light emitting units.

Kido teaches:

Paragraph [0025], teaches the invention of Kido is directed to organic electroluminescent devices having at least one charge generating layer and at least two light emissive units which provide higher luminance than electroluminescent devices having only a single light emissive unit.

Paragraph [0027], teaches the charge generating layer(s) include laminated and/or mixed layers. A charge transfer complex having a radical cation and radical anion is formed.

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Paragraphs [0041]-[0049], teach an electron injection layer on the anode side of the charge generation layer. The electron injection layer can comprise an organic metal complex or inorganic compound and a reaction generating layer formed by in-situ reduction with a thermally reducible metal. Aluminum, zirconium, silicon, titanium, and tungsten are taught as thermally reducible metals. The passage additionally teaches the layer can be a mixed layer.

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Liu as further evidence:

Liu is added to provide the charge mobility of holes and electron in alpha-NPD (NPB). Figure 1 of Liu, 142106-2, teaches the charge mobility of holes and electrons in NPB at various electric field strengths.

It would have been obvious to one of ordinary skill in the art to provide a plurality of light emissive units of Heeney with the charge generation units of Kido therebetween to obtain increased luminance in the resulting device as observed by Kido.

9. Claims 1-6, 9-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takasu et al., US 2004/0258954 in view of Heeney et al., EP 1,439,590 and Ikeda et al., WO 2005/031798, and Hosokawa, US 2002/0045061 and Kido et al., US 2003/0189401 with further evidence provided by Liu et al., Applied Physics Letters, (2007), Volume 91, 142106 and Angelopoulos et al., US 5,198,153.

Takasu teaches:

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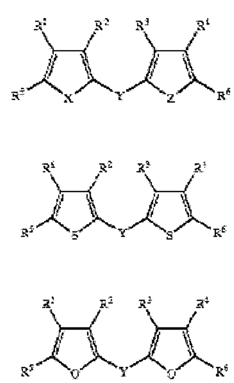
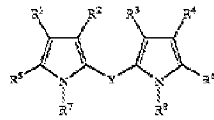




Paragraph [0032], teaches Y of the formulae represents an arylene group.

Paragraphs [0098], [0104], [0112], [0121], [0125], [0128], provide exemplified compounds in which further fused rings are formed from R^1, R^2 and R^3, R^4.

Paragraph [0059], teaches various electroluminescent device structures. The passage additionally teaches the materials of the formulae can be used in the hole injection, hole transport, and luminescent layers of the device.

Paragraph [0061], teaches various materials suitable for use in the layers of the electroluminescent device.

Paragraphs [0067]-[0068], figures 2A, 2B, teach the use of the electroluminescent device as a pixel

Paragraphs [0086]-[0089], teach the use of the electroluminescent device in various display applications including televisions, personal computers, and telephones.

Takasu does not teach:

Takasu does not teach an electron acceptor as a dopant to the layer comprising the material of the formulae.

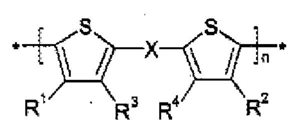
Takasu does not teach the use of the materials of the formulae in the electron transport/injection layers of an electroluminescent device.

Heeney teaches:

Paragraph [0102], teaches an electroluminescent device comprising mono-, oligo- or poly-mers of formula (I). The passage additionally teaches multilayer electroluminescent

device structures comprising hole transport layer(s), electron transport layer(s) and emission layer(s) and applying a voltage across such a structure.

Paragraphs [0026]-[0029], [0080], claim 1, formula (I), teach mono-, oligo- or poly-mers of formula (I), shown below, in the charge transport, charge injection, or electroluminescent layers of an organic light emitting diode. The mers of formula (I) can be used alone or in combination. X of formula (I) can be a substituted or unsubstituted arylene or heteroarylene group.



Paragraphs [0077]-[0079], teaches the compositions comprising mers of formula (I) can further comprise additional materials including transition metal compounds. The passage also incorporates by reference, Angelopoulos et al., US 5,198,153 in paragraph [0077].

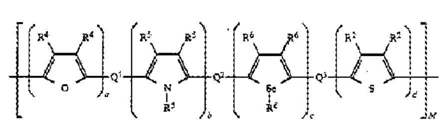
Paragraphs [0028] [0030]-[0033], [0080], teach the use of the materials of formula (I) in displays and backlights.

Angelopoulos as further evidence:

Angelopoulos is incorporated by reference into Heeney in paragraph [0077].

Column 17, lines 52-57, teach doped polymers can provide conductivity on the order of 10 ohm^{-1} cm^{-1}.

Column 16, lines 8-24, formula, teach suitable (co)polymers include thiophenes, furans, pyrroles and combinations thereof. The formula is reproduced below.



It would have been obvious to one of ordinary skill in the art to use the doped thiophene, furan, and pyrrole (co)polymers as taught by Heeney in device of Takasu as charge transporting materials in the light emitting, hole injection/transport and electron injection/transport layers to provide high conductivity to the layer(s) of the device to improve device efficiency.

Takasu / Heeney does not teach:

Takasu / Heeney does not teach transition metal oxides.

Ikeda teaches:

Abstract, teaches a light emitting device comprising a layer which further comprises a hole transporting compound and a oxide semiconductor or metal oxide.

Page 3, teaches exemplified examples of the oxide semiconductor or metal oxide. The examples include vanadium oxide, molybdenum oxide, tungsten oxide and ruthenium oxide.

It would have been obvious to one of ordinary skill in the art to use the transition metal oxides of Ikeda as the transition metal compounds suggested by Heeney to obtain the improved charge transportation and improved device life as observed by Ikeda.

Takasu / Heeney does not teach:

Takasu does not teach an electron generation layer.

Hosokawa teaches:

Paragraphs [0109]-[0115], teach a hole barrier layer improves device performance by confining holes in the luminescence layer. The passage additionally provides a preferred

composition of the hole barrier layer comprising BPhen or BCP in combination with Li or Cs.

Paragraph [0160], example 3, teaches 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (Bathocuproine)(BCP) co-deposited with cesium in a hole barrier layer deposited upon the luminescent layer.

Paragraph [0103], teaches it is preferred to include a semiconductor layer having an electrical conductivity of at least 10^{-10} S/cm between the anode and light emitting layer.

It would have been obvious to one of ordinary skill in the art to use the hole barrier layer of Hosokawa in the device of Takasu to improve the hole confinement in the light emitting layer and improve device performance as suggested by Hosokawa.

It would have been obvious to one of ordinary skill in the art to include a layer of the doped material of Takasu/Heeney in the device of Takasu/Heeney between the anode and light emitting layer to provide a high conductivity layer to improve hole injection into the light emitting layer. Such a layer would be expected to meet the limitations of a electron generation layer as indicated on page 18 of the instant specification.

Takasu / Heeney / Ikeda /Hosokawa does not teach:

Heeney does not teach a device structure comprising a plurality of light emitting units.

Kido teaches:

Paragraph [0025], teaches the invention of Kido is directed to organic electroluminescent devices having at least one charge generating layer and at least two light emissive units

which provide higher luminance than electroluminescent devices having only a single light emissive unit.

Paragraph [0027], teaches the charge generating layer(s) include laminated and/or mixed layers. A charge transfer complex having a radical cation and radical anion is formed.

Paragraph [0028], teaches it is desirable for the charge generation layer to include an organic compound having an ionization potential of less than 5.7 eV and a second inorganic or organic compound capable of forming a charge transfer complex therewith.

Paragraphs [0029]-[0032] and [0119]-[0134], formula (I), teach an organic compound preferably having a glass transition temperature of not lower than 90 degrees Celsius. Suitable arylamine example compounds are presented including alpha-NPD.

Paragraphs [0038]-[0040], [0255], teach the organic material can include fluoro groups, cyano groups, and both fluoro and cyano groups. (4F-TCNQ) tetrafluoro-tetracyano-quinodimethane is presented as an example of a suitable compound. The structure of (4F-TCNQ) is presented in paragraph [0255].

Paragraphs [0041]-[0049], teach an electron injection layer on the anode side of the charge generation layer. The electron injection layer can comprise an organic metal complex or inorganic compound and a reaction generating layer formed by in-situ reduction with a thermally reducible metal. Aluminum, zirconium, silicon, titanium, and tungsten are taught as thermally reducible metals. The passage additionally teaches the layer can be a mixed layer.

Paragraphs [0050]-[0052], teach a hole injection layer comprising an organic compound and electron accepting compound. The electron accepting compound can oxidize the organic compound.

Paragraph [0135], [0141] and [0142], teach the charge generating layer can also function as the hole transporting layer. The passage also teaches the charge generation layer can be a mixed layer further comprising a substance capable of forming a charge-transfer complex with the arylamine component.

Paragraph [0155], teaches an organic layer adjacent to the cathode can comprise an organic metal complex having as the metal of the complex an alkaline or alkaline earth metal and a thermally reducible metal such as Al.

Paragraphs [0293]-[0305], example 6, figure 41, teaches a reaction generating layer of Liq and Al adjacent to the charge generation layer. The charge generation layer comprises vanadium pentaoxide and alpha-NPD.

Liu as further evidence:

Liu is added to provide the charge mobility of holes and electron in alpha-NPD (NPB). Figure 1 of Liu, 142106-2, teaches the charge mobility of holes and electrons in NPB at various electric field strengths.

It would have been obvious to one of ordinary skill in the art to provide a plurality of light emissive units of Takasu with the charge generation units of Kido therebetween to obtain increased luminance in the resulting device as observed by Kido.

Response to Arguments

10. Applicant's arguments have been considered but are moot in view of the new ground(s) of rejection.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brett A. Crouse whose telephone number is (571)-272-6494. The examiner can normally be reached on Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, D. Lawrence Tarazano can be reached on 571-272-1515. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/B. A. C./
Examiner, Art Unit 1786

/D. Lawrence Tarazano/
Supervisory Patent Examiner, Art Unit 1786